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(54) Abstract Title

**A punch for perforating a cementitious tile**

(57) A cementitious tile 60 is perforated using a punch 10 of elongate section having a leading face 16 with a saw tooth profile along its length. The punch may also be used to produce indentations which look like perforations when in situ. Circular punches also having a saw tooth profile may be used. The tooth depth is preferable less than 2mm and the included angle of the tooth profile between 90° and 150°. The punches are arranged on a punch plate (20 Fig 4).

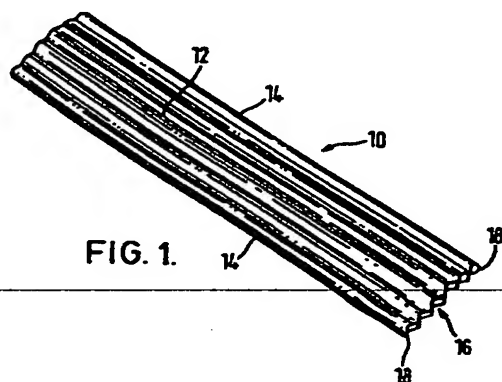


FIG. 1.

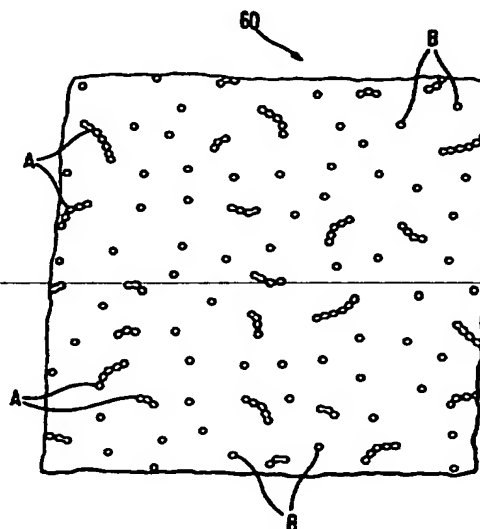


FIG. 6.

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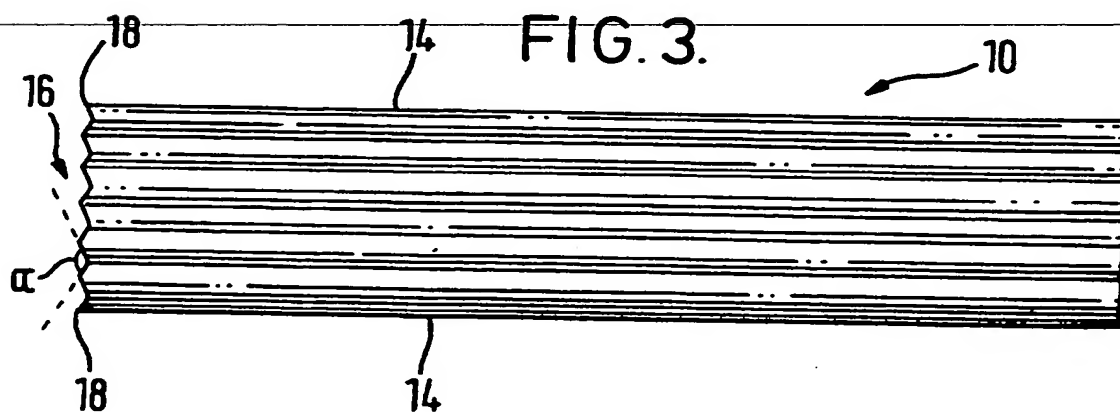
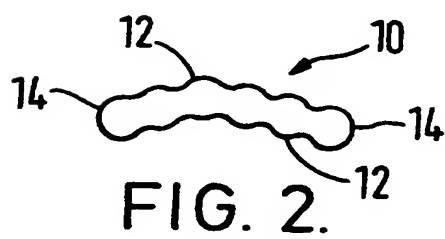
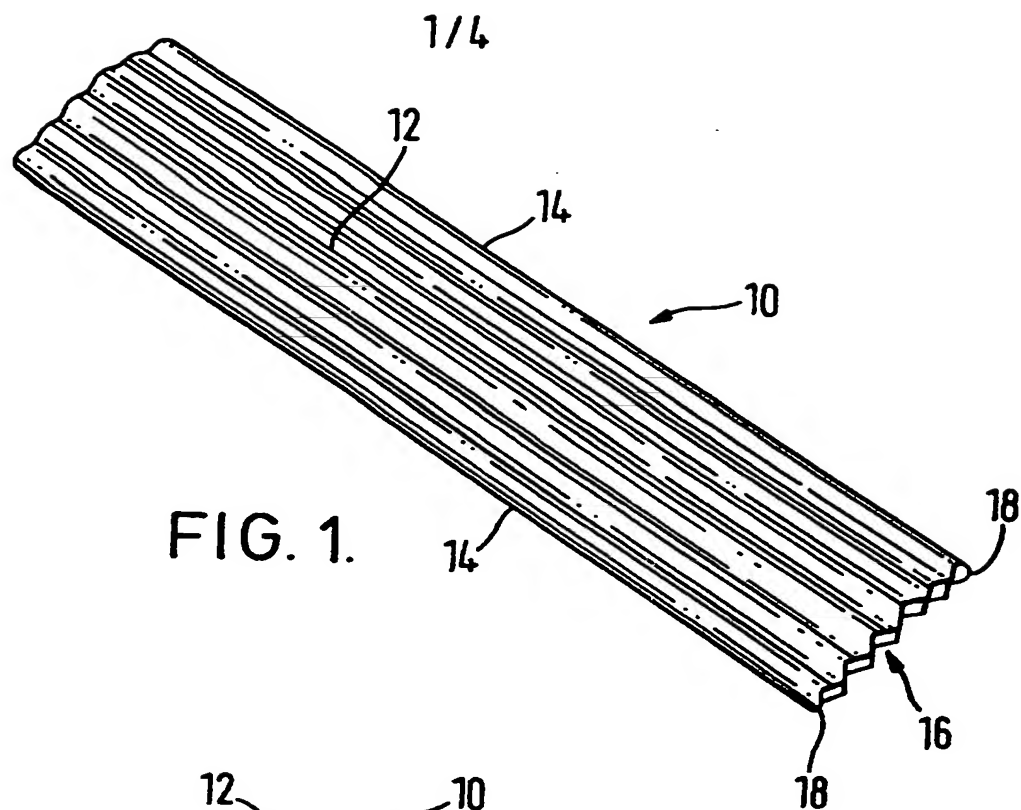
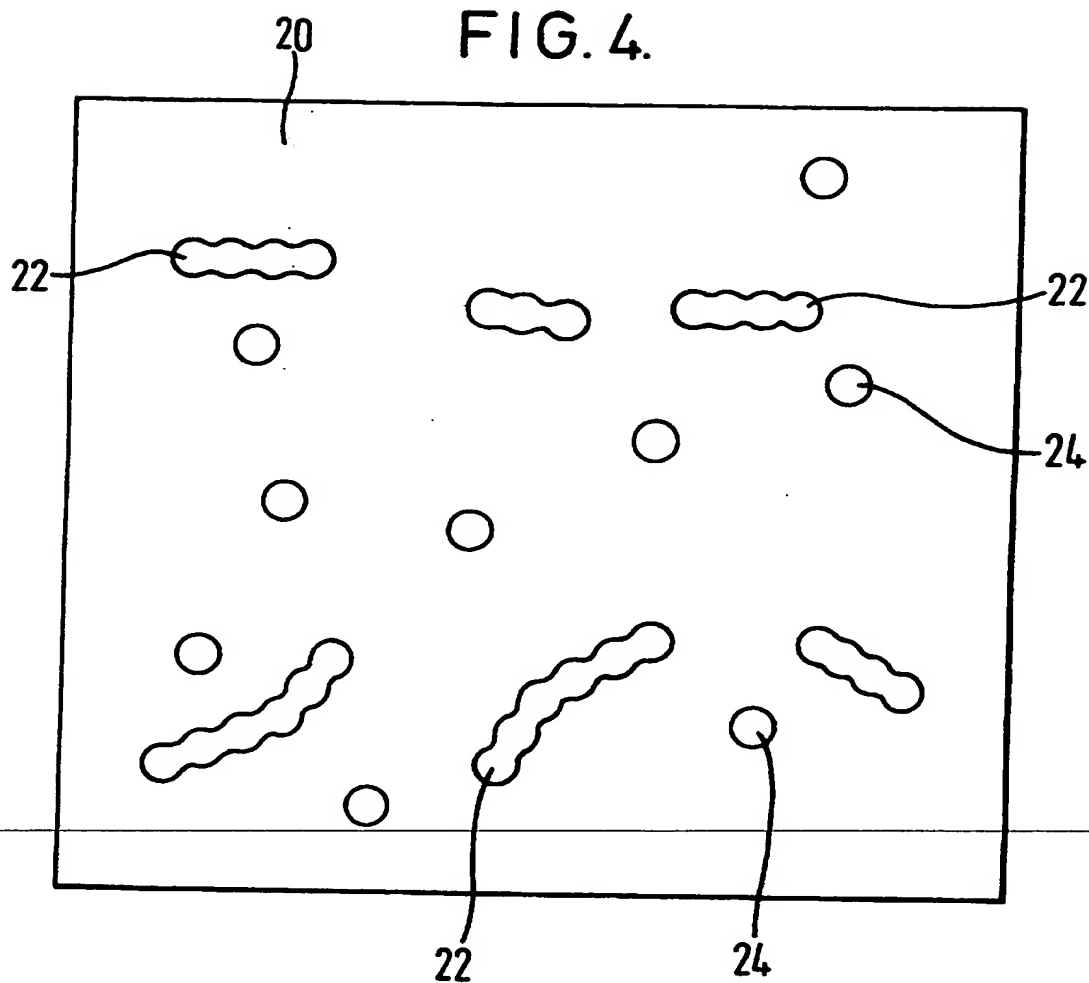
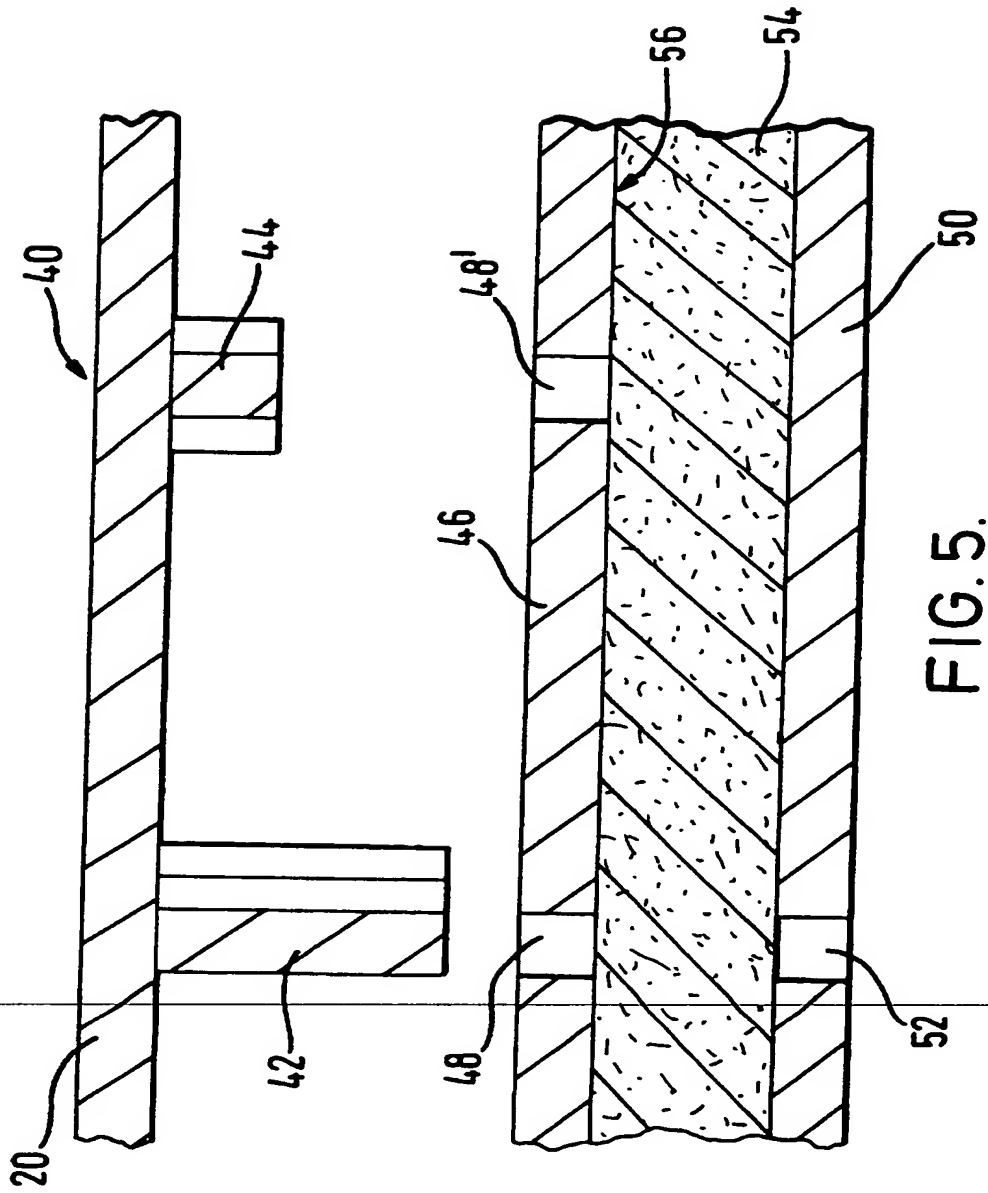


FIG. 4.





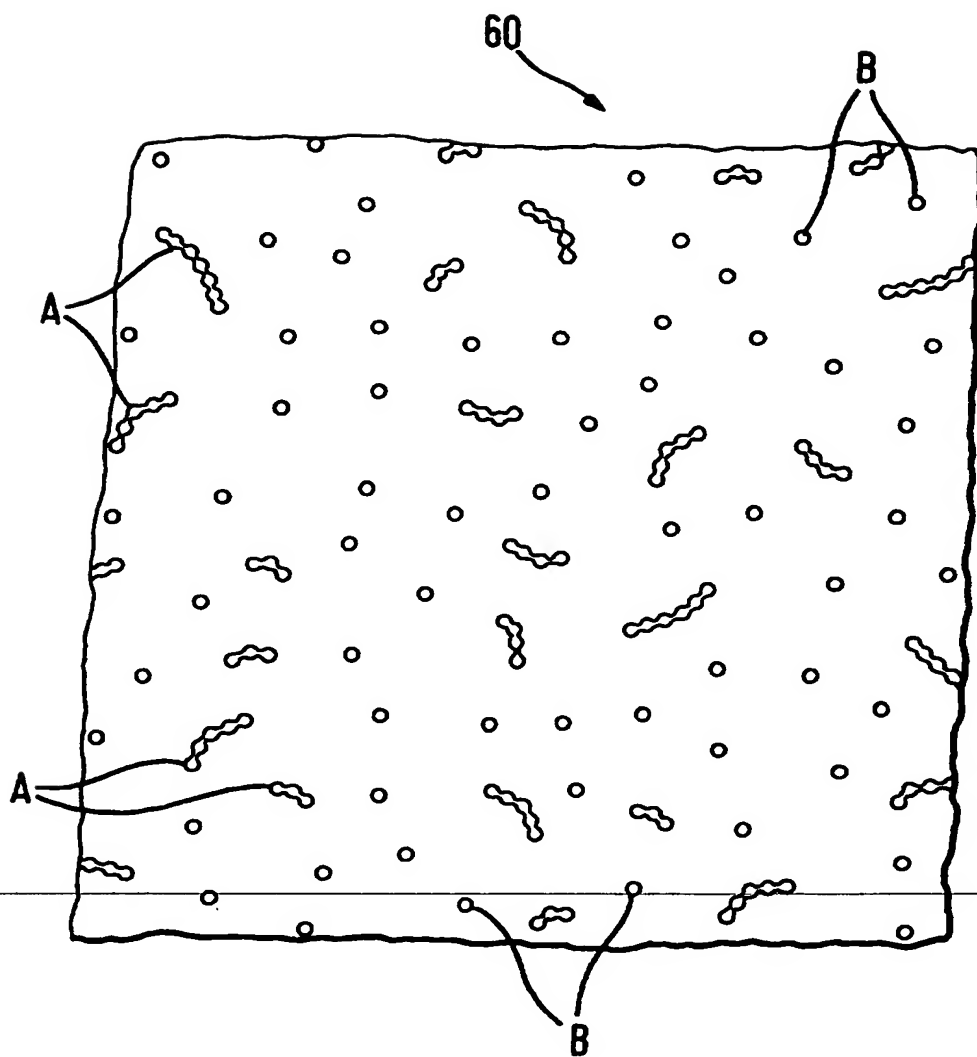


FIG. 6.

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**CEMENTITIOUS TILE**

The present invention relates to a cementitious tile having good acoustic properties, to a method of making such a tile and to a die assembly for use in the method.

Board made from gypsum plaster is generically termed plasterboard. Conventional paper faced plasterboard is used as a cladding for building interiors, either to give, or to provide a base for, the desired decorative finish.

Plasterboard has been successfully used in other applications, such as ceiling tiles, but has not generally been very successful in applications where good acoustic absorption properties are required. GB-A-2 203 772 discloses a plasterboard having relatively good acoustic absorption properties. The board is perforated by holes or slits which are covered on one face of the board by cloth bonded to the board. WO-A-87/00116 discloses a plasterboard for use as an acoustic tile perforated with regular slots. It has been desired to improve the acoustic absorption properties of plasterboard tiles; it has also been desired to achieve this in a tile of aesthetically pleasing appearance.

In known perforated plasterboard tiles, the edges of the perforations tend to be somewhat indistinct, perhaps because fibres from the lining material extend into them.

According to the present invention, there is provided a sound absorbent tile comprising cementitious material having perforations which extend into the cementitious material, characterised in that at least some of the perforations have unusually sharp, well defined, edges. Preferably, at least some of the perforations are fissure-like perforations. Also preferably some of the perforations are circular in section.

By "fissure-like" is meant generally elongate perforations having irregular edges, preferably with an aspect ratio (the ratio of the length of the fissure to its maximum width) of at most 6:1, preferably no more than 4:1. An aspect ratio of at least 2:1 is preferred.

Preferably, the tile is lined, for example with a paper liner and the lined surface has an array of indentations which extend through the liner and terminate in the cementitious material. The liner of the plasterboard is ruptured, giving rise to a product of distinctive appearance. The liner is forced into the indentations during their formation giving rise to a level of contrast in between the two extremes produced by the machining operations described previously.

Preferably, the openings of the through perforations on the side of the board opposite the lined surface (if any) are covered. In an especially preferred embodiment, these openings are covered with a sound absorbent material, preferably in sheet form such as acoustic paper or felt.

Also according to the invention there is provided a punch of elongate section for perforating a tile comprising cementitious material, the leading face of the punch having a saw tooth profile along its length.

Preferably, the punch is shaped to form fissure-like perforations.

Preferably, the side faces of the punch are corrugated along the length of the punch, and the end faces are rounded.

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Also preferably, the pitch of the saw tooth profile is substantially the same as the pitch of the corrugations.

Also according to the invention, there is provided a punch for perforating a tile comprising cementitious material, the punch having a leading face with a saw tooth profile, the leading face having rounded edges and a tooth depth no greater than 2 mm.

Preferably, the punch embodying the invention has a tooth depth no greater than 2mm.

Preferably, the included angle between teeth is between  $90^{\circ}$  and  $150^{\circ}$ . Preferably, the profile is at a peak at each end of the leading face of the punch.

A punch embodying this aspect of the invention may be circular.

There is further provided a sound absorbent tile comprising cementitious material having a plurality of punched perforations which extend into the cementitious material, the perforations having a cut quality index greater than 0.98 wherein the cut quality index is defined as the ratio of pixels occupied by the perimeter of a digitised image of a perforation after a smoothing operation to the number of pixels occupied by the digitised image of the perimeter before the smoothing operation, the smoothing operation comprising four levels of binary erosion followed by binary dilation.

Also according to the invention there is provided a die assembly for use in perforating cementitious board, comprising a punch plate and punches according to the invention arranged in an array on the surface of the punch plate, the punches preferably each having a fissure-like profile to form fissure-like perforations in a board. Preferably, the punches of the die assembly include short indenter punches and long through punches, the indenter punches being arranged on the surface of the punch plate and extending a smaller distance from the said surface than do the long punches. Particularly preferably, the punch plate also carries circular punches for producing circular perforations in the board.

It is preferred that the long punches extend beyond the indenter punches by an amount at least as great as the thickness of the cementitious board so that the long punches will have passed through the board before the indenter punches impinge on the board, thus making the through



perforations before the indentations. By making the perforations before the indentations, the size of the press required to put the die assembly into operation is kept to a minimum.

It is also preferred that the die assembly includes a stripper plate and a die plate between which a tile is sandwiched to be perforated. The stripper plate has holes therethrough to allow the punches to pass through the plate and into the tile, and the die plate has holes therethrough for the passage of the punches after they have perforated the tile.

Also according to the invention there is provided a method of manufacturing a sound absorbent tile of cementitious board comprising:

contacting a planar surface of a cementitious board with the profiled surface of a punch plate having punches according to the invention thereon, the shapes of at least some of the punches preferably being such as to form fissure-like perforations;

perforating the board applying pressure between the board and the die such that the punches pass through the board; and

thereafter separating the punch plate from the board.

Preferably, the punches include short indentor punches and long through punches, the method comprising embedding all the punches in the board so that the indentor punches penetrate but do not pass through the board and the long punches pass through the board.

---

If the board is lined, it is preferred that the punch plate impinges on the lined surface.

In a preferred method, the planar surface of the board is painted after the board has been punched and indented. In this way, any liner forced into the indentations can be left unpainted, particularly if the paint is applied with a roller for example. Painting

provides a way of varying the degree of contrast between the indentations and the rest of the board.

In an especially preferred method, the surface of the board is spiked using a roller having radially extending spikes. Spiking can be used to produce fine pinholes in the surface of the board which gives a particularly pleasing appearance in combination with fissure-like perforations and indentations.

Also according to the invention there is provided a suspended ceiling comprising the tiles of the invention. Such a ceiling can have non-uniform acoustic properties and a substantially uniform appearance by using a mixture of tiles according to the invention and tiles of similar appearance having no through perforations but only fissure-like indentations. Ceilings can thus be made having desired overall acoustic properties; for example a ceiling can be made which is particularly suitable for an auditorium where speech must be clearly audible throughout.

An embodiment of the invention will now be described in detail, by way of example, with reference to the accompanying drawings in which:

Figure 1 shows a perspective view of a punch according to the invention;

Figure 2 shows a cross-section through the punch of Figure 1;

Figure 3 shows a side elevation of the punch of Figures 1 and 2;

Figure 4 shows schematically a plan view of a punch plate for use in a die assembly according to the invention, with the punches absent;

Figure 5 is a schematic cross sectional view of a die assembly according to the invention in use to make a tile according to the invention; and

Figure 6 shows part of a tile according to the invention.

The punch 10 shown in Figures 1, 2 and 3 is solid and made of high carbon steel. It is of elongate section with a change of direction part way along the section, shaped to form a fissure-like perforation in a plasterboard tile. The side faces 12 of punch are corrugated, and the end faces 14 are rounded. In another embodiment, the end faces taper to a ridge; the perforations formed in the tile by punches of this embodiment have more pointed ends than those formed by the punches of Figures 1, 2 and 3. The leading face 16, that is, the face which in use impinges first on the tile being perforated, has a saw tooth profile along its length. The pitch of the saw tooth profile is the same as that of the corrugations, 3 mm. The preferred included angle  $\alpha$  is  $120^\circ$ ; this has been found to give perforations with sharp, clean edges. As is best seen in Figure 3, the saw tooth profile of the leading face 16 is such that there is a peak 18 at each end of the face.

A punch intended to be used both to perforate and indent tiles may have teeth with an included angle of between  $115^\circ$  to  $150^\circ$ . A preferred range is  $120^\circ$  to  $130^\circ$ . The tooth depth, that is the distance between the tooth tip and base is preferably up to 1.5 mm with a preferred depth of 1.0 mm.

Where the punch is intended to be used only to perforate, the included angle may be between  $90^\circ$  to  $150^\circ$  with a preferred range of  $110^\circ$  to  $130^\circ$  and a still preferred angle of  $120^\circ$ . The tooth depth may be up to 2 mm with a preferred depth of 1 mm.

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The angles and depth of the punch for use with a fully perforated punch are less critical. Where a tile is being indented, the depth of the hole is important. The correct depth will product a shadow that is very similar to that produced by a full perforation. As will be explained, this is useful as it allows perforated and indented tiles to be mixed without loss of aesthetic effect. If the tooth angle is too great, or the tooth depth too large, the tips

of the teeth will penetrate the bottom paper of the tile while still only indenting the tile. This has an unwanted aesthetic effect and may vary the acoustic properties.

The punches 10 are, in use, mounted in a punch plate 20, shown in Figure 4. The punch plate has punch holes 22 corresponding to various shapes of punch 10, as well as circular punch holes 24 for circular punches. The circular punches also have a leading face having a saw tooth profile and have preferred and acceptable included angles between teeth and tooth depths as the elongate punch illustrated in Figure 3. Moreover, it has been found that the circular punches having the preferred profile can produce cuts as clean as those produced by the elongate punch. By providing a punch plate 20 having a large number of punch holes 22, 24, a variety of punch patterns can be made without changing the punch plate, by rearranging or removing some of the punches.

The punch plate 20 can be provided with long and short punches, the long punches for making through perforations in the plasterboard tile and the short punches for making perforations or indentations extending into but not passing through the tile.

Both the punches 10 and the holes 22, 24 in the punch plate 20 are preferably formed by wire erosion cutting. This enables the punches to fit the holes very accurately, to a total tolerance of about 5  $\mu\text{m}$  (that is, for a circular hole, 2.5  $\mu\text{m}$  around the circumference). This enables exact reproduction of punch patterns to be achieved.

Figure 5 illustrates part of a die assembly 40 which includes long punches 42 and short indenter punches 44 attached to a punch plate 20. The punches 42 are as shown in Figures 1, 2 and 3, and the punch plate 20 is as shown in Figure 4.

The die assembly 40 also includes a top, stripper, plate 46 having apertures 48, 48' corresponding to and large enough to accommodate the long punches 42 and short indenter punches 44, and a bottom, die, plate 50 having apertures 52

corresponding to the long punches 42. In use, the die assembly 40 is mounted in a press and a lined plasterboard tile 54 is sandwiched between the rigidly mounted stripper 46 and die 56 plates. As the punch plate 20 is moved towards the tile 54, the punches and then the indentors exert a pressure of about  $1.5 \text{ MN/m}^2$  on the tile. The long punches 42 pass through the apertures 48 in the stripper plate 46 and press into the plasterboard. The long punches 42 force plugs of plasterboard through the openings 52 in the die plate 50. In this way, the perforations are formed in the tile 54 before the short indentor punches 44 engage the tile. As the punch plate 18 continues to advance towards the tile 54, the short indentor punches 44 pass through the holes 48' in the stripper plate 46 and are embedded in the tile. Once the paper liner 56 of the tile 54 has been ruptured by the short indentor punches 44, the operation is complete and the punch plate 18 is withdrawn.

The clearances between the long punches 42 and the corresponding holes 52 in the die plate 50 should be chosen to ensure that the paper backing, if any, of the plasterboard tile 54 is cut cleanly away where the punches exit the plasterboard, while allowing the punches to be withdrawn from the die plate. If the top face of the tile is lined, for example with paper, the appearance of the top surface of the tile can be determined by the clearance between the punches 42,44 and the holes 48,48' through the stripper plate 46. A very small clearance will give perforations and indentations having sharply defined edges while a greater clearance will give perforations and indentations with less well defined edges, where the fibres of the liner material are visible at those edges.

The holes 52 in the die plate 46 is preferably made by wire erosion, as are the punches 42,44 and the punch mounting holes in the punch plate 20. This enables a very close fit to be achieved between the punches and the holes

in the die plate, giving a very clean edge to the exit holes.

After being punched, the fissure (or fissure and circular hole) pattern on the tile can be supplemented by a pinhole pattern imposed by spiking the surface of the plasterboard using a roller having spikes mounted radially on its periphery. The spikes in contact with the tile at any given time have a much smaller cross sectional area than the punches 42,44 so the force on the roller required to drive the spikes into the plasterboard is significantly less than the force required on the punch plate 18 to produce the fissure indentations.

A tile 60 produced by use of the die assembly 10 is shown in Figure 6. The tile has fissure-like indentations A and circular perforations B. Preferably the ratio of fissure-like to circular perforations is preferably within the range 2:1 to 1:2. It has been found that satisfactory acoustic properties are achieved, without significant loss of strength, when about 6% of the total area of the principal faces of the tile has perforations. An aesthetically pleasing effect is achieved when additionally about 6% of the total area of the front face of the tile has indentations which do not pass through the tile.

By varying the proportion of the surface area of the tile taken up by perforations, the acoustic properties of the tiles can be varied. The appearance of the tiles can be kept constant by providing indentations instead of perforations; the indentations have no significant effect on the acoustic properties of the tile.

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Tiles according to the invention, which can be made using punches according to the invention, have very sharp, clean holes on both surfaces. This provides an attractive finish to the tiles, which cannot be achieved with prior art techniques.

One use of tiles according to the invention is in the constructions of suspended ceilings. It may be desired to

provide an acoustically absorbent suspended ceiling having different acoustic properties in different parts. Tiles of similar appearance to those of the invention can be manufactured having no perforations but only fissure-like indentations; such tiles can be used with tiles according to the invention having to provide a suspended ceiling of uniform appearance but with acoustic properties which vary over the ceiling.

As discussed above, a punch embodying the invention may be used to produce a perforated or indented cementitious tile that has exceptionally clean edges to the perforations or indentations. These edges are unusually sharp, well defined, edges.

The cleanliness or sharpness of the edge may be measured and a quantitative measure of edge quality derived.

It has been observed that a rough hole will have a larger perimeter for a given shape compared to an ideal minimum, due to the jagged edge of a rough hole. Thus, for a simple example of a circular hole the ideal perimeter is  $2\pi D$ . For a very jagged edge, the actual perimeter may be in the order of  $2.5\pi D$  where  $D$  is the diameter of the hole.

As perimeter values will vary with hole shape, frequency and size, we have developed a technique for deriving an absolute measure of hole cleanliness using perimeter smoothing techniques.

A digital image of the hole is formed and the periphery is measured, for example by counting the number of pixels occupied by the perimeter successive smoothing operations. Measurements may be made using an Optimas 5.2 image analysis system with Cohu high performance CCD camera on a Kaiser copy stand. A 50 mm Cosmocar TV lens at  $f/5.6$  was used with a 10 mm extension tube and 2 shims. The column height was 42.2 mm with the camera mounted on the front tripod socket giving a resultant magnification on a 10 mm thick tile of  $\times 5.325$ . Correct illumination is important to achieve satisfactory results. This may be

achieved by positioning four 75 watt tungsten lamps at the lowest angle, widest spacing and greatest separation possible. Adequate illumination is achieved with two pairs of lamps either side of the specimen at a distance of 56 cm from the optical axis, with 30 cm spacing between lamps and at a height of 12.5 cm above the tile surface. As the perimeter is smoothed, so the perimeter length and the number of pixels occupied by the perimeter decreases. The cut quality is then defined as the ratio of measured perimeter after smoothing operations to that of the original. It will be appreciated that a high figure indicates a smooth cut as the smoothing operations have not reduced the perimeter greatly.

The value will vary according to the number of smoothing operations performed. For the present purposes, the measurement is defined as the ratio of pixels occupied by the perimeter after four smoothing operations performed using a standard smoothing algorithm.

To achieve reproducible results, the final cut quality index is a mean value of a number of measurements, for example 16, with the samples rotated  $45^\circ$  per set of measurements to eliminate any orientation effects.

On this basis, an index of 1 would indicate an ideal perimeter and the lower the index the worse the perimeter quality. We have found that a hole punched with the preferred punch of Figures 1 to 3 having an included angle of  $120^\circ$  and a tooth depth of 1 mm has an index of 0.99, whereas a prototype punch has an index of 0.90. We have further established that a cut, to be visually acceptable must have a cleanliness index greater or equal to 0.98.

The smoothing algorithm used is a standard binary erosion followed by a binary dilation. The first level comprises one erosion and then one dilation. In binary morphology an erosion is an operation where foreground pixels that are 8-connected (referring to neighbouring pixels left, right, above, below and on the diagonals) to a



background pixel are eliminated. A dilation is the opposite of an erosion. After segmenting a grey scale image into a binary image, the dilate operation identifies background pixels that are 8-connected to a foreground pixel and changes them to foreground. Finally, the dilated bit-map is copied to the frame grabber.

The erosion operation is performed by an erode filter which performs grey scale to binary (white on black only) conversion and then does a binary erosion operation. The bit-map is then copied back. The filter uses the following arguments:

Arg0: NULL use the current region of interest (ROI)  
Arg2: NULL use default lower foreground value(s)  
Arg3: NULL use default upper foreground value(s)  
Arg4: NULL use default 3by3 square structuring element  
Arg6: NULL every pixel is in the Arg4 by Arg5 rectangular structuring element.  
Arg7: NULL the origin in the X direction is located at width/2  
Arg8: NULL the origin in the Y direction is located at height/2

The dilation operation is performed using a dilation filter which enlarges foreground regions of an image by performing grey scale to binary (white on black only) conversion and then a binary dilation operation. The dilated bit-map is then copied back. The arguments used are as follows:

---

Arg0: NULL use the current region of interest (ROI)  
Arg2: NULL use default lower foreground value(s)  
Arg3: NULL use default upper foreground value(s)  
Arg4: NULL use default 3by3 square structuring element  
Arg6: NULL every pixel is in the Arg4 by Arg5 rectangular structuring element.

Arg7: NULL the origin in the X direction is located at width/2

Arg8: NULL the origin in the Y direction is located at height/2

An outline filter is also used to create white boundaries around foreground regions. This function first thresholds a grey scale image into foreground and background components. Foreground pixels in the resulting binary image which are 4-connected to a background pixel remain unchanged. All other pixels change to background. This produces an 8-connected foreground boundary. The outline bit-map is then copied back to the frame grabber. This filter uses the following arguments:

Arg0: NULL use the current region of interest (ROI)

Arg1: NULL use default lower foreground value(s)

Arg2: NULL use default upper foreground value(s)

The Optimas macro is shown below from which it will be seen that there are four iterations of the smoothing algorithm. The first level has been described. The second level uses two erosions and then two dilations, the third level three erosions and then three dilations etc.

We have determined that an acceptable cut quality is achieved where the perforations have an index of 0.98 or greater measured as the average of 16 sets of measurements, each involving four iterations of the smoothing algorithm as discussed above at a magnification of x 5.325. Preferably, the index is 0.99 or greater.

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We have also determined that unacceptable cut qualities fall below the index of 0.98. The following results were obtained:

Sample	Shape of Perforation	% Perimeter Mean Value after 16 Fields	Standard Deviation (n-1)
R&D pilot 1/2 tool	circular & elongate	0.90	0.024
Gyptone Quattro 20	square	0.97	0.010
Gyptone Line No 4	rectangular slots	0.97	0.020
Yoshino Board	circular	0.96	0.018
Production tool	circular & elongate	0.99	0.100

# Image Analysis Script - Optimas Smoothing Algorithm

```
GrayToBinary (,0.0,67.0);
```

```
OutlineFilter();  
Histogram(NULL);  
MacroMessage (ArRO|HistogramStats[0]/255);  
Undo();
```

```
BINB_ilterations=1;  
ErodeFilter(,BINB_ilterations);  
DilateFilter(,BINB_ilterations);  
BINB_ilterations=1;  
OutlineFilter();  
Histogram(NULL);  
MacroMessage (ArRO|HistogramStats[0]/255);  
Undo();
```

```
BINB_ilterations=2;  
ErodeFilter(,BINB_ilterations);  
DilateFilter(,BINB_ilterations);  
BINB_ilterations=1;  
OutlineFilter();  
Histogram(NULL);  
MacroMessage (ArRO|HistogramStats[0]/255);  
Undo();
```

```
BINB_ilterations=3;  
ErodeFilter(,BINB_ilterations);  
DilateFilter(,BINB_ilterations);  
BINB_ilterations=1;  
OutlineFilter();  
Histogram(NULL);  
MacroMessage (ArRO|HistogramStats[0]/255);  
Undo();
```

```
BINB_ilterations=4;  
ErodeFilter(,BINB_ilterations);  
DilateFilter(,BINB_ilterations);  
BINB_ilterations=1;  
OutlineFilter();  
Histogram(NULL);  
MacroMessage (ArRO|HistogramStats[0]/255);  
Undo();
```

---

CLAIMS

1. A punch of elongate section for perforating a tile comprising cementitious material, the leading face of the punch having a saw tooth profile along its length.
  2. A punch according to claim 1, in which the profile is at a peak at each end of the leading face of the punch.
  3. A punch according to claim 1 or 2, in which the included angle of the saw tooth profile is in the range  $90^{\circ}$  to  $150^{\circ}$ .
  4. A punch according to claim 3, in which the included angle of the saw tooth profile is in the range  $115^{\circ}$  to  $150^{\circ}$ .
  5. A punch according to claim 5, wherein the included angle of the saw tooth profile is about  $120^{\circ}$ .
  6. A punch according to any preceding claim, wherein the saw tooth depth is less than or equal to 2 mm.
  7. A punch according to claim 6, wherein the saw tooth depth is less than or equal to 1.5 mm.
  8. A punch according to claim 7, wherein the saw tooth depth is less than or equal to 1 mm.
- 
9. A punch according to any preceding claim, in which the side face is corrugated along the length of the punch.
  10. A punch according to claim 9, in which the pitch of the saw tooth profile is substantially the same as the pitch of the corrugations.

11. A punch according to claim 10, in which the pitch of the saw tooth profile and of the corrugations is about 3 mm.
12. A punch according to any preceding claim, in which the end faces are rounded.
13. A punch according to any preceding claim, in which the punch is shaped to form a fissure-like perforations.
14. A punch according to any preceding claim, wherein the punch is solid.
15. A punch for perforating a tile comprising cementitious material, the punch having a leading face with a saw tooth profile, the leading face having rounded edges and a tooth depth no greater than 2 mm.
16. A die assembly for use in perforating cementitious board comprising a punch plate and punches arranged on the surface of the punch plate, the punches being according to any of claims 1 to 15.
17. A die assembly according to claim 16, in which the punches are aligned substantially in the same direction.
18. A die assembly according to claim 16 or 17, in which at least some of the punches are shorter punches for penetrating a cementitious board, the shorter punches being ~~arranged on the surface of the punch plate and extending a~~ smaller distance from the said plate than do the longer punches.
19. A die assembly according to claim 18, in which the long punches extend beyond the short punches by an amount at least as great as the thickness of a cementitious board to

be punched so that long punches will have passed through the board before the short punches impinge on the board.

20. A method of manufacturing a sound absorbent tile of cementitious board comprising:

contacting a planar surface of a cementitious board with the profiled surface of a punch plate having punches thereon, at least some of the punches being according to any of claims 1 to 8;

perforating the board by applying pressure between the board and the die such that the punches pass through the board; and

thereafter separating the punch plate from the board.

21. A method according to claim 20, in which the board is plasterboard.

22. A method according to claim 21, in further comprising perforating the board with substantially circular perforations.

23. A method according to claim 19, 20 or 21, in which the punches include short punches and long punches, the method comprising embedding all the punches in the board so that the short punches penetrate the board but do not pass through it and the long punches pass through the board.

24. A method according to any of claims 19 to 23, in which the board is lined.

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25. A method according to claim 24, in which the punch plate is applied to the lined face of the board.

26. A method according to any of claims 19 to 25, further comprising painting a planar surface of the board after separating the punch plate from the board.

27. A method according to any of claims 19 to 26, further comprising spiking the surface of the board using a roller having radially extending spikes.
28. A method according to any of claims 19 to 27, further comprising covering the openings of the perforations on one side of the board.
29. A method according to claim 28, in which the openings are covered with sound absorptive material.
30. A method according to any of claims 19 to 29, in which the through perforations are formed before the indenter punches are embedded in the board.
31. A sound absorbent tile comprising cementitious material having a plurality of punched perforations which extend into the cementitious material, the perforations having a cut quality index greater than 0.98 wherein the cut quality index is defined as the ratio of pixels occupied by the perimeter of a digitised image of a perforation after a smoothing operation to the number of pixels occupied by the digitised image of the perimeter before the smoothing operation, the smoothing operation comprising four levels of binary erosion followed by binary dilation.
32. A cementitious tile according to claim 31, wherein the cut quality index is at least 0.99.
- 
33. A cementitious tile according to claim 31 or 32, wherein the cut quality index is derived from a mean of a plurality of measurements of cut quality index.
34. A cementitious tile according to claim 33, wherein the mean value is derived from 16 sets of measurements of the cut quality index.



35. A cementitious tile according to any of claims 31 to 34, wherein the pixels are derived by a digital camera operating at a magnification of x 5.325.

36. A punch substantially as described with reference to Figures 1, 2 and 3 of the drawings.

37. A die assembly substantially as described with reference to Figures 4 and 5 of the drawings.

38. A method substantially as described.



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Application No: GB 9807775.3  
Claims searched: 31-35

Examiner: Hal Young  
Date of search: 14 September 1998

**Patents Act 1977**  
**Further Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): E1D

Int Cl (Ed.6): E04B(1/86)

Other:

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2203772 A (GYPROC)	
A	GB 2056911 A (ARMSTRONG)	
A	US 4898056 (GYPROC)	

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The  
Patent  
Office

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Application No: GB 9807775.3  
Claims searched: 1-30

Examiner: Hal Young  
Date of search: 8 June 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B4B ; B6J

Int Cl (Ed.6): B26F(1/00, 02, 14, 44) ; B44C(1/24)

Other:

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Category	Identity of document and relevant passage	Relevant to claims
A	GB 2309985 A (BPB)	
X	GB 2281242 A (ASSI), see page 2 lines 1-29.	1, 13
X	GB 819146 (STANDARD), see fig 9.	1,9,13
A	GB 803835 (GROHMANN)	
A	GB 791560 (SIMPSON)	
X	GB 474894 (FRENCH), see figs 1-8.	1,13
X	GB 385114 (TIMSON), see figs noting saw tooth blade 1.	1 at least
A	US 4898056 (GYPROC)	
X	US 4825740 (MUCCI), see fig 5.	1 at least
X	US 3792637 (CONTAINER), see figs.	1 at least

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